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Technical/Final Report
to
Saskatchewan Agriculture Development Fund

Breed Related Copper Deficiency in Cattle

R-86-01-0063

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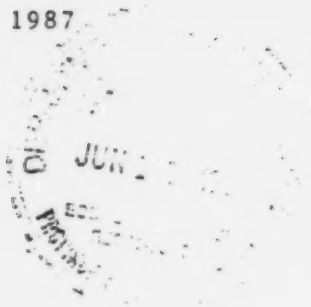
SASKATOON CANADA
S7N 0W0

June 9, 1987



Dr. John Taylor, Manager
Agriculture Development Fund
Walter Scott Building
3085 Albert Street
Regina, Sask.
S4S 0B1

Your file: R-86-01-0063

Dear Dr. Taylor:

Your letter concerning the project on "Breed Related Copper Deficiency in Cattle" was set aside for what should have been a short period of time near the end of term, and I did not rediscover it until several days ago. In that letter you asked for a statement explaining why the project is important to Saskatchewan, as well as for several sentences explaining why Simmental is important to Saskatchewan and to this project.

This project is important in defining circumstances under which a copper deficiency may occur, especially the effects of sulfur and molybdenum on the availability of copper and the effects of different proportions of these interferring substances on the availability of copper. The importance of the Simmental breed in research concerns their apparent susceptibility of certain animals of that breed to a copper deficiency. The very significant difference in copper excretion has been observed in this work, between Simmental and Angus cattle. In addition, a number of other metabolic differences between individual cattle and cattle of different breeds come to light as a result of this research. I will be suggesting in the near future some change in the direction of this research to include evaluation of the practical significance of some of these newly discovered metabolic differences. They may have very great significance in breeding and selection programs.

Sorry for the oversight in not replying to your letter more promptly.

Sincerely yours,

D. A. Christensen,
Professor and Head

DAC/dmr

FINAL

~~PROGRESS~~ REPORT ON AGRICULTURE DEVELOPMENT FUND GRANT AWARDED FOR STUDIES ON "BREED RELATED COPPER DEFICIENCY IN CATTLE"

TITLE OF AWARD: Breed related copper deficiency in cattle.

APPLICANT: D. A. Christensen

CO-INVESTIGATORS: S. B. Gooneratne

INSTITUTION: Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, Sask. S7N 0W0

PROJECT NO: R-86-01-0063

STARTING DATE: May 1986

COMPLETION DATE: April 1990

KEYWORDS: copper, deficiency, cattle, breed, differences, molybdenum, sulfur, interactions

(a) EXECUTIVE SUMMARY

1. ABSTRACT:

A study was carried out to determine copper excretion in bile and urine in a breed more susceptible to copper (Cu) deficiency (Simmental) and a breed with a lesser susceptibility to Cu deficiency (Angus). Plasma Cu levels, and bile, urine and fecal Cu excretion were monitored in 8 cattle (4 Simmental and 4 Angus) while they were on either a low or high Cu diet. Bile Cu excretion in Simmental was approximately twice as that of Angus. Increasing the dietary Cu from 5 ppm to 40 ppm increased the biliary Cu excretion by approximately 60% to 80% in both breeds. Experiment is still in progress, but it appears that why Simmental breed exhibit Cu deficiency disorders more often, is at least partly because of their increased excretion of Cu via bile.

2. SUMMARY:

This project was aimed at obtaining basic information on copper (Cu) excretion in bile and urine in a breed with a higher susceptibility to Cu deficiency (Simmental) and a breed with a lesser susceptibility to Cu deficiency (Angus). Eight, 1 year old heifers (4 Simmental and 4 Angus) were maintained on a low Cu diet for 2 months prior to surgically preparing them for collection of bile. After a post-surgical stabilization period of 2 months, plasma Cu levels, and bile, urine and fecal Cu excretion were monitored while they were on either a low or high Cu diet. Mean bile Cu excretion in Simmental while on a low diet was 688 ug/24h compared with 320 ug/24h in Angus. Increasing the dietary Cu from 5 ppm to 40 ppm increased the biliary Cu excretion by approximately 60% to 80% in both breeds. Experiment is still in progress but it appears that why Simmental breed exhibit Cu deficiency more often than other breeds is at least partly because of its

inherent ability to excrete more Cu from its body via bile.

It appears now that Simmental breed is more at risk of develcping Cu deficiency due to their increased capacity to excrete more Cu via bile, and hence the necessity for recommendation of a high level of Cu supplementation to this breed.

(b) TECHNICAL REPORT

ABSTRACT:

A study was carried out to determine copper (Cu) excretion in bile and urine in a breed with a higher susceptibility to Cu deficiency (Simmental) and a breed with a lesser susceptibility to Cu deficiency (Angus). Eight 1 year old heifers were surgically prepared for collection of bile. Plasma Cu levels, and bile, urine and fecal Cu excretion were monitored in 8 cattle (4 Simmental and 4 Angus) while they were on either a low or a high Cu diet. Bile Cu excretion in Simmental was approximately twice as that of Angus. Increasing the dietary Cu from 5 ppm to 40 ppm increased the biliary Cu excretion by approximately 60% to 80%. Experiment is still in progress, but it appears that why Simmental breed exhibit Cu deficiency disorder more often, is at least partly because of their increased excretion of Cu via bile.

BACKGROUND:

Copper (Cu) is an essential trace element. Its deficiency in cattle is associated with depression of growth, unthriftiness, infertility and abnormalities in fetal development and birth of weak calves. Copper deficiency in cattle is widespread in Saskatchewan, and is most commonly observed in the Simmental breed of cattle.

OBJECTIVE(S):

1) To determine variations in Cu metabolism between animals across 2 breeds, Simmental and Angus.

2) To determine importance of bile as a route of Cu loss.

3) To compare changes in plasma Cu bile, urine and fecal Cu excretion among 2 breeds fed high (40 ppm) and low (5 ppm) Cu diets.

Given above are the objectives for the first year of the program only, and are consistent with the objectives outlined in the grant application.

EXPERIMENTAL METHODS:

Eight, 1 year old heifers (4 Simmental and 4 Angus) were maintained on a low Cu diet for 2 months prior to surgically preparing them for collection of bile. After a post-surgical stabilization period of 2 months, plasma Cu levels, and bile, urine, and fecal Cu excretion were monitored, while they were on either a low or a high Cu diet. The experiment is still in progress. As outlined in the milestone definition of the original application, the results of this experiment on the effects of high Mo and/or S on biliary Cu excretion will be available in November, 1988.

RESULTS AND DISCUSSION: Level of Cu in the diet did not affect either the bile or the urine flow (Table 1). Biliary Cu excretion in Simmental breed was at least 2 fold higher than in the Angus. In both breeds higher Cu supplementation (40 ppm) increased the Cu excretion in bile by approximately 60% to 80%.

To our knowledge this is the first report on breed related Cu excretion in bile with loss of biliary Cu in the Simmental breed being very high.

Fecal and plasma samples are presently being analyzed.

CONCLUSION:

Breed related Cu deficiency is identified. Simmental cattle appear to be more susceptible. This is probably at least partly due to their inherent capacity to excrete more Cu via bile.

TABLE 1. Bile and Urine flow *(Litres/24h) and Total Copper Excretion in Bile and Urine **(ug/24h) In Simmental and Angus Breeds of Cattle (Results are expressed as Mean ± SD)

SAMPLE	BILE				URINE			
BREED	SIMMENTAL		ANGUS		SIMMENTAL		ANGUS	
MEASUREMENT	FLOW*	COPPER** EXCRETION	FLOW*	COPPER** EXCRETION	FLOW*	COPPER** EXCRETION	FLOW*	COPPER** EXCRETION
LOW COPPER DIET (5 mg/kg DM)	9.54 ± 0.82	688 ± 36	9.35 ± 0.13	320 ± 64	6.83 ± 0.23	688 ± 160	6.30 ± 1.10	440 ± 76
HIGH COPPER DIET (40mg/kg DM)	10.39 ± 0.29	1112 ± 72	11.93 ± 1.59	568 ± 132	7.98 ± 1.48	808 ± 48	8.75 ± 1.19	836 ± 60

IMPACT:

These results may prove the necessity for recommendation of higher Cu supplementation to certain breeds of cattle such as Simmental.

c) LIST OF PAPERS:

This project was discussed briefly in the following publication.

S. R. Gooneratne (1986). "Copper nutrition of beef cows. Effect of sulfate and molybdenum, and species susceptibility". In the Proceedings of the 7th Western Nutrition Conference, p. 266-292, University of Saskatchewan, Saskatoon.

d) VERIFIED STATEMENT OF EXPENDITURE: Enclosed.

e) LIST OF PERSONNEL INVOLVED AND PERCENT OF THEIR TIME INVOLVED TO THE PROJECT

PERSONNEL	% TIME INVOLVED IN THE PROJECT
D. A. Christensen	5
R. Gooneratne	100
T. Berryere	60
A. Olkowski	40

Agricultural Development Fund

Project #86-01-0063
Breed Related Copper Deficiency in Cattle
Financial Projection Feb 1 to March 31,1987

Salaries and Fringe Benefits	20,000
Materials and Supplies	8,000
	$28,000